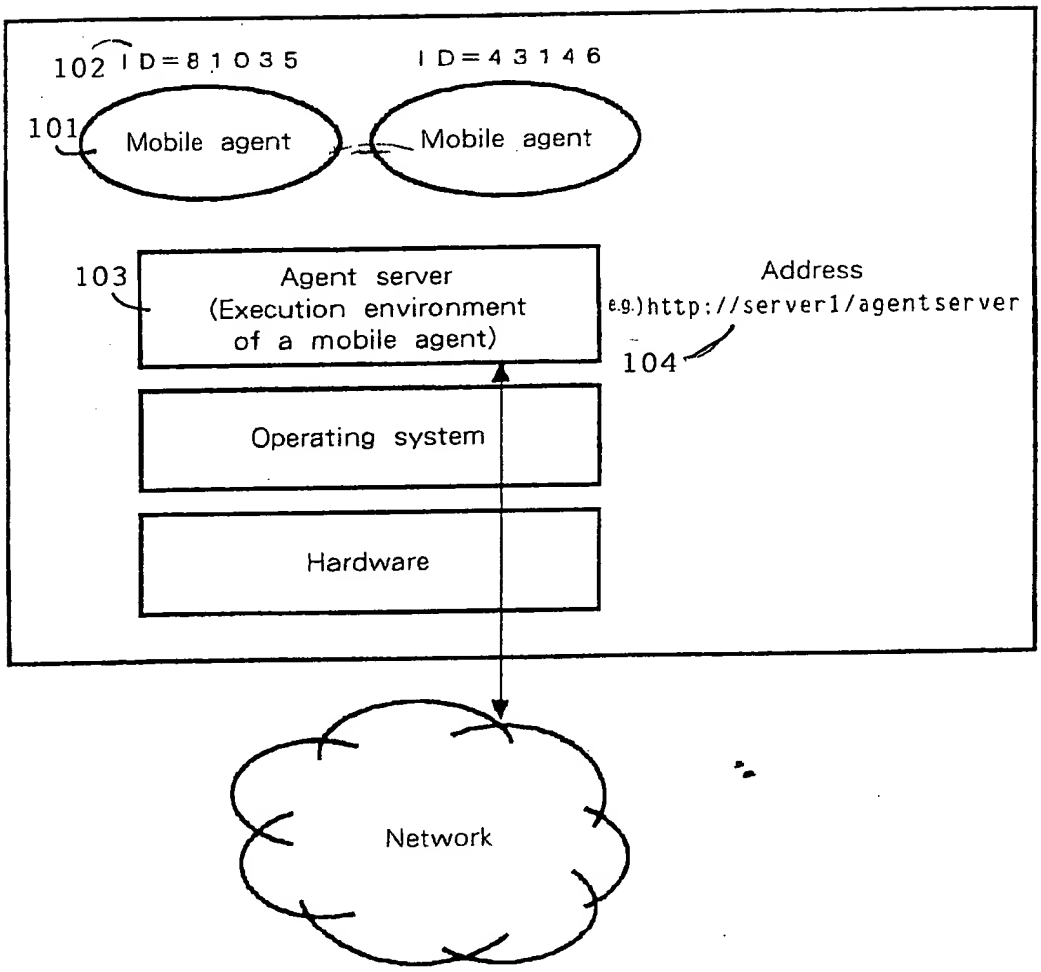
REPLACEMENT DRAWING



REPLACEMENT SHEET

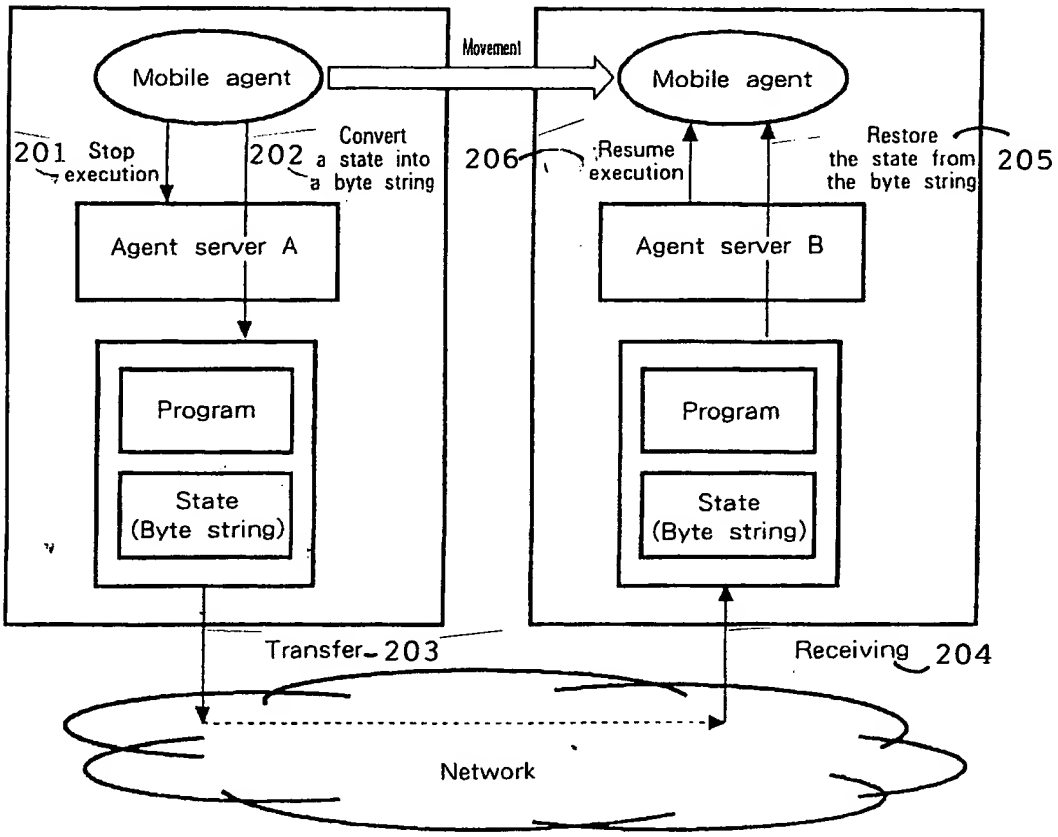


Fig. 2

REPLACEMENT SHEET

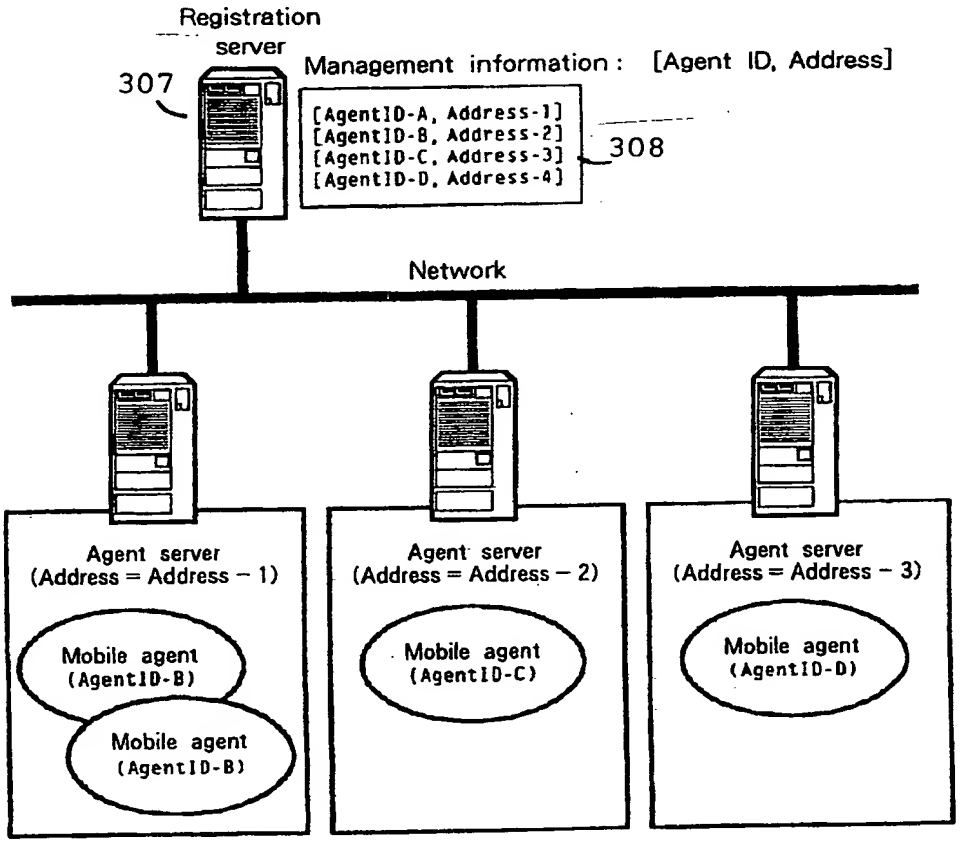


Fig. 3

REPLACEMENT SHEET

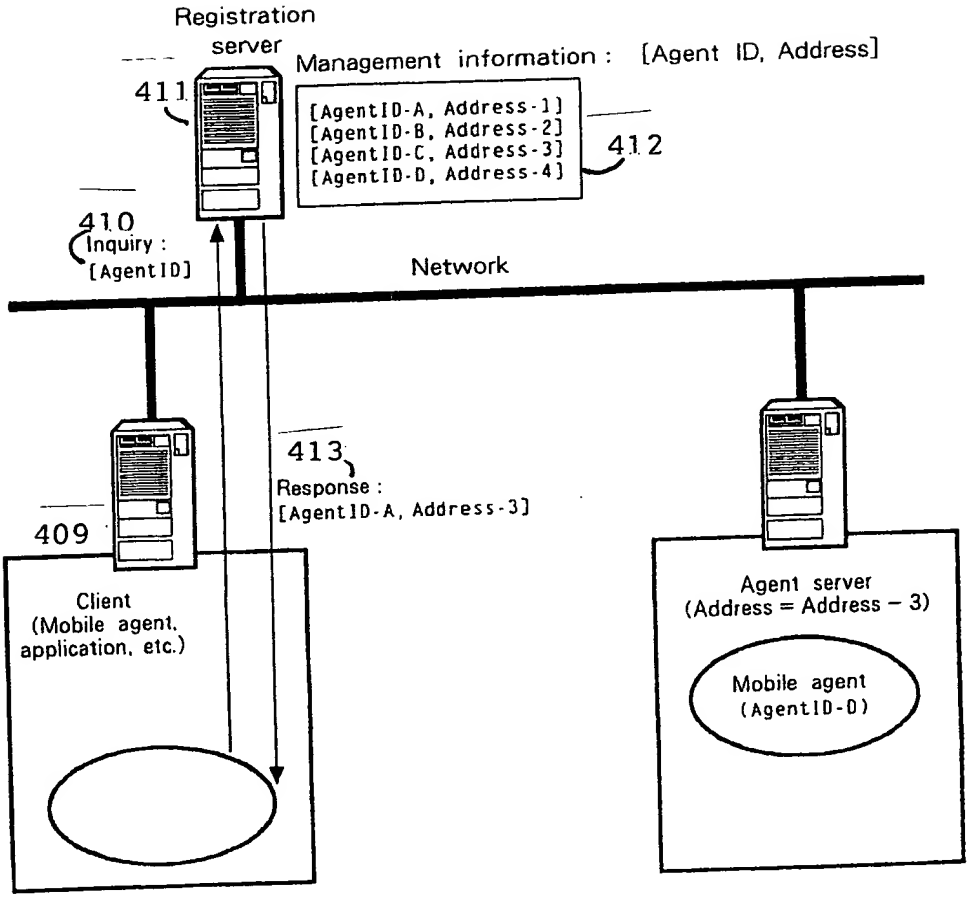


Fig. 4

REPLACEMENT SHEET

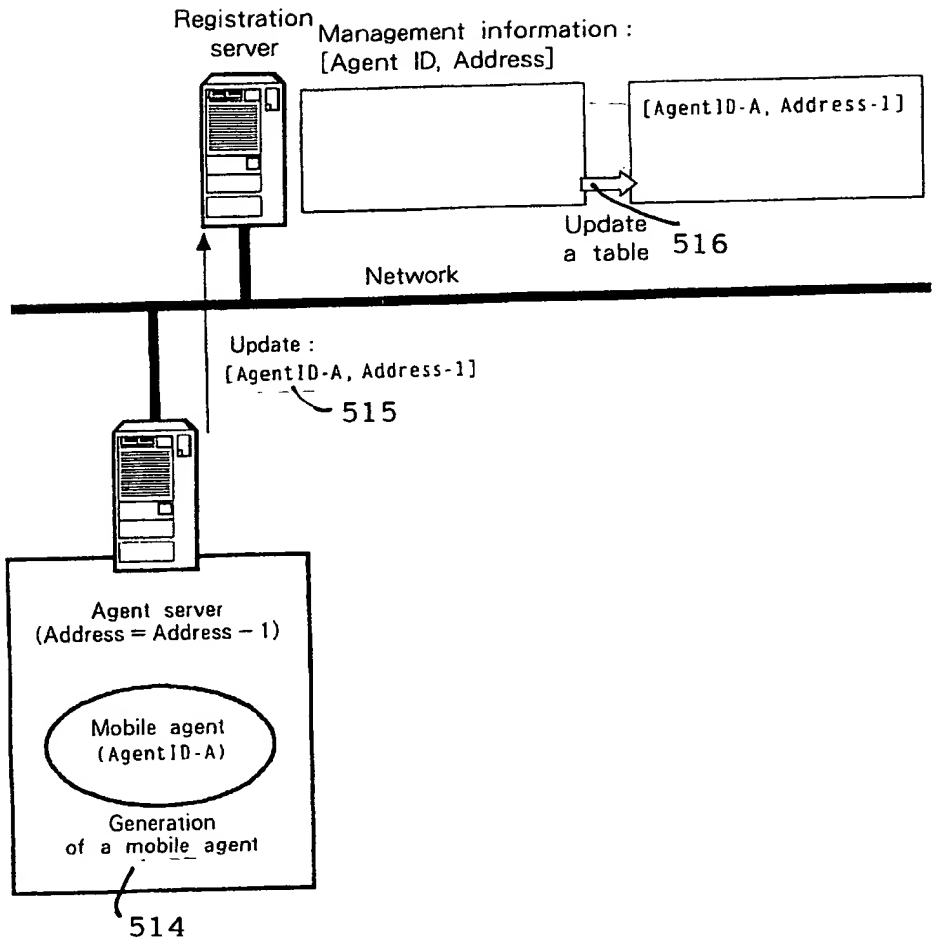


Fig. 5

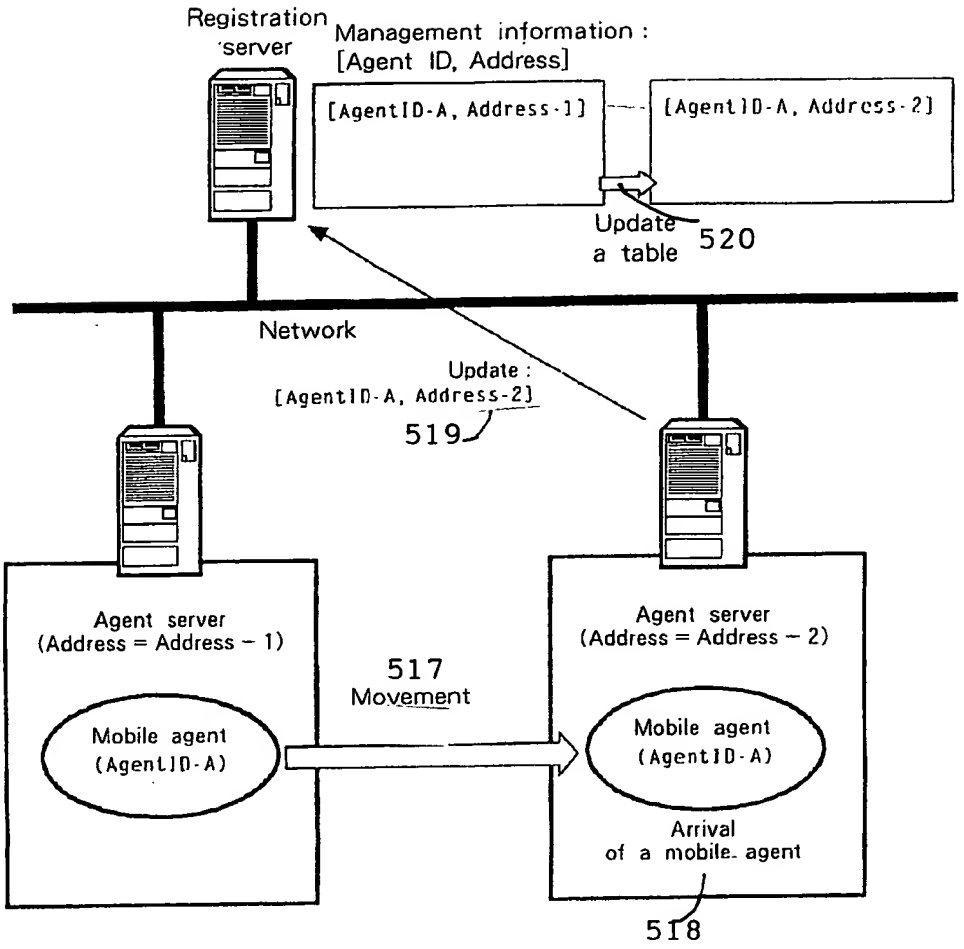

Registration server
Management information : [Agent ID, Address]
[AgentID-A, Address-1]
[AgentID-A, Address-2]
Update a table
520
Network
Update : [AgentID-A, Address-2]
519
Agent server (Address = Address – 1)
Mobile agent (AgentID-A)
517 Movement
Agent server (Address = Address – 2)
Mobile agent (AgentID-A)
Arrival of a mobile agent
518

Fig. 6

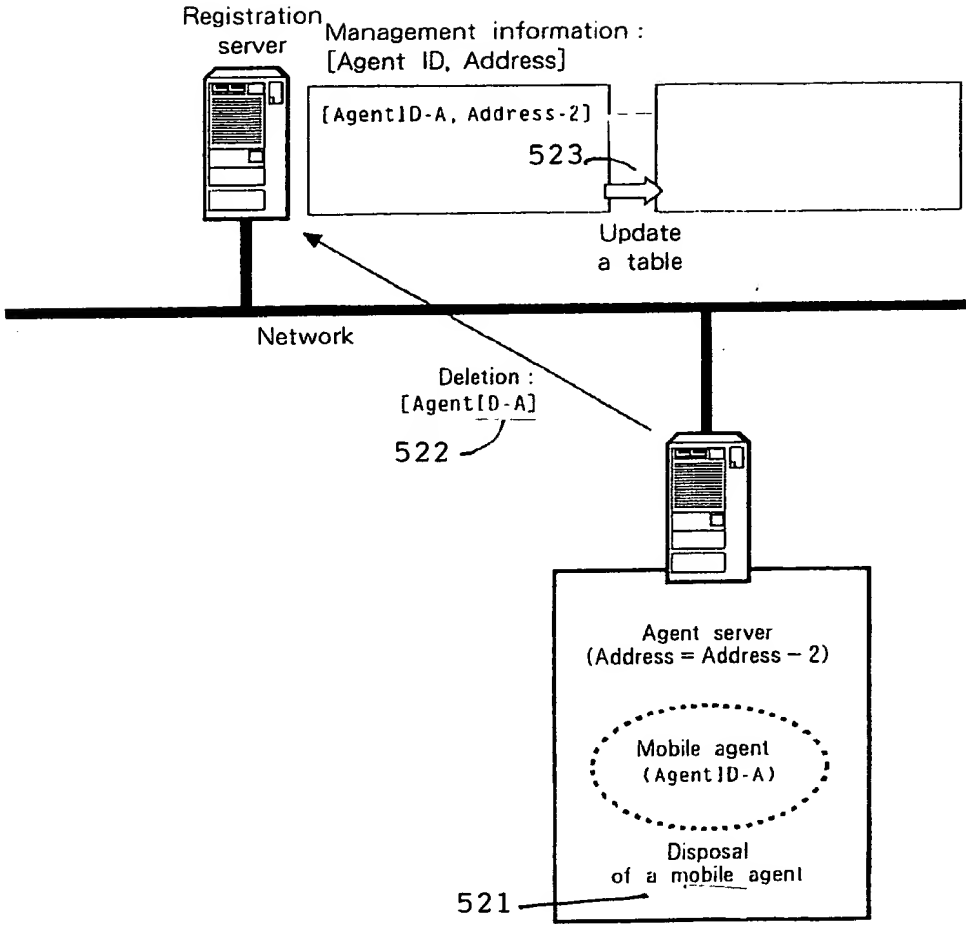

Registration server
Management information : [Agent ID, Address]
[AgentID-A, Address-2]
523
Update a table
Network
Deletion : [AgentID-A]
522
Agent server (Address = Address – 2)
Mobile agent (AgentID-A)
Disposal of a mobile agent
521

Fig. 7

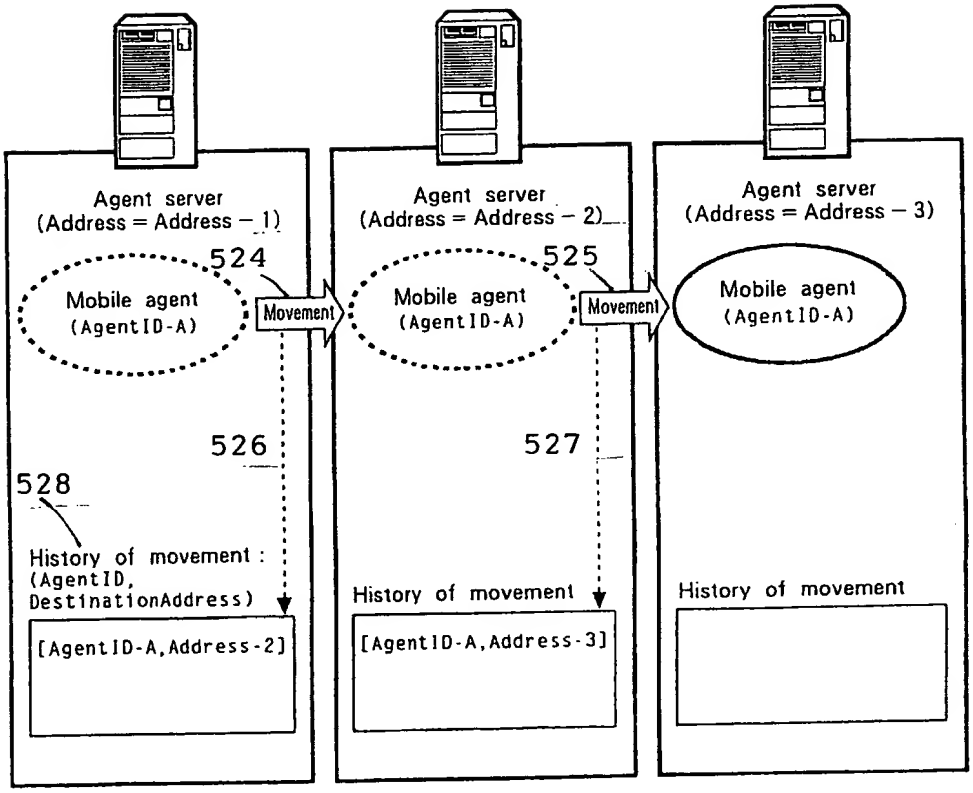

Agent server
(Address = Address – 1)
524
Mobile agent
(AgentID-A)
Movement
526
528
History of movement :
(AgentID,
DestinationAddress)
[AgentID-A,Address-2]
Agent server
(Address = Address – 2)
525
Mobile agent
(AgentID-A)
Movement
527
History of movement
[AgentID-A,Address-3]
Agent server
(Address = Address – 3)
Mobile agent
(AgentID-A)
History of movement

Fig. 8

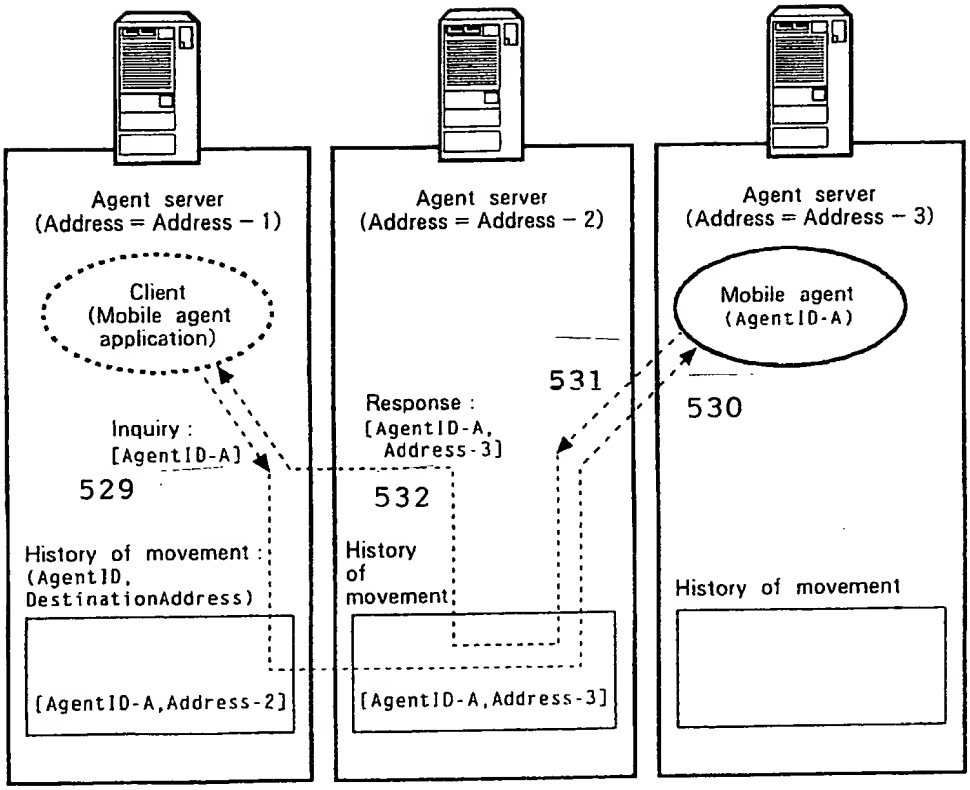

Agent server
(Address = Address – 1)
Client
(Mobile agent
application)
Inquiry :
[AgentID-A]
529
History of movement :
(AgentID,
DestinationAddress)
[AgentID-A,Address-2]
Agent server
(Address = Address – 2)
Response :
[AgentID-A,
Address-3]
532
History
of
movement
[AgentID-A,Address-3]
Agent server
(Address = Address – 3)
Mobile agent
(AgentID-A)
531
530
History of movement

Fig. 9

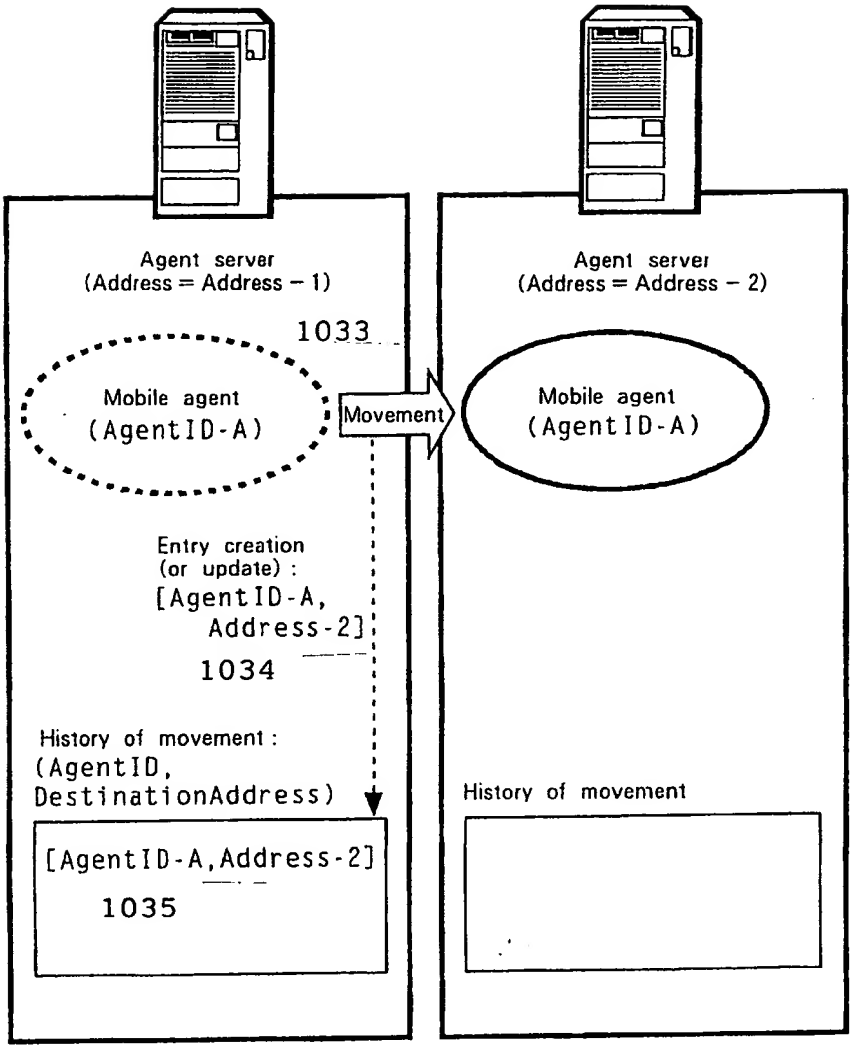

Agent server
(Address = Address – 1)
1033
Mobile agent
(AgentID-A)
Movement
Agent server
(Address = Address – 2)
Mobile agent
(AgentID-A)
Entry creation
(or update) :
[AgentID-A,
Address-2]
1034
History of movement :
(AgentID,
DestinationAddress)
[AgentID-A,Address-2]
1035
History of movement

Fig. 10

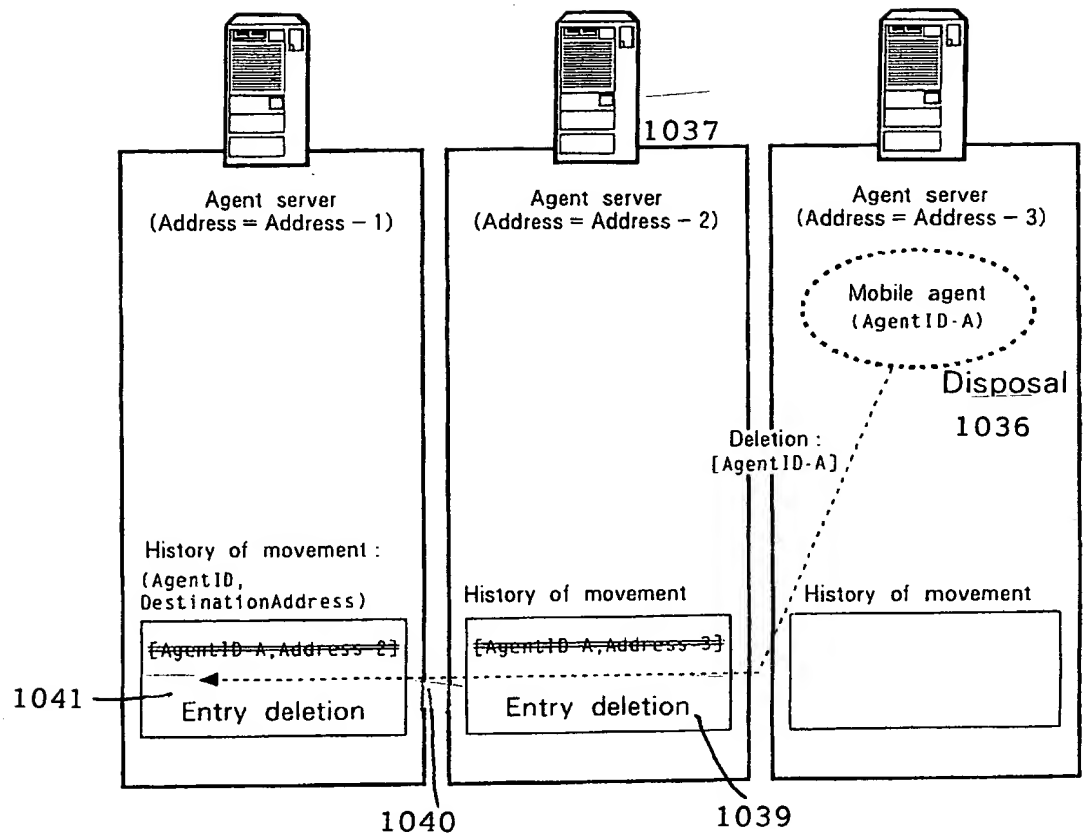

1037
Agent server
(Address = Address – 1)
Agent server
(Address = Address – 2)
Agent server
(Address = Address – 3)
Mobile agent
(AgentID-A)
Disposal
1036
Deletion :
[AgentID-A]
History of movement :
(AgentID,
DestinationAddress)
History of movement
History of movement
[AgentID-A,Address-2]
[AgentID-A,Address-3]
1041
Entry deletion
Entry deletion
1040
1039

Fig. 11

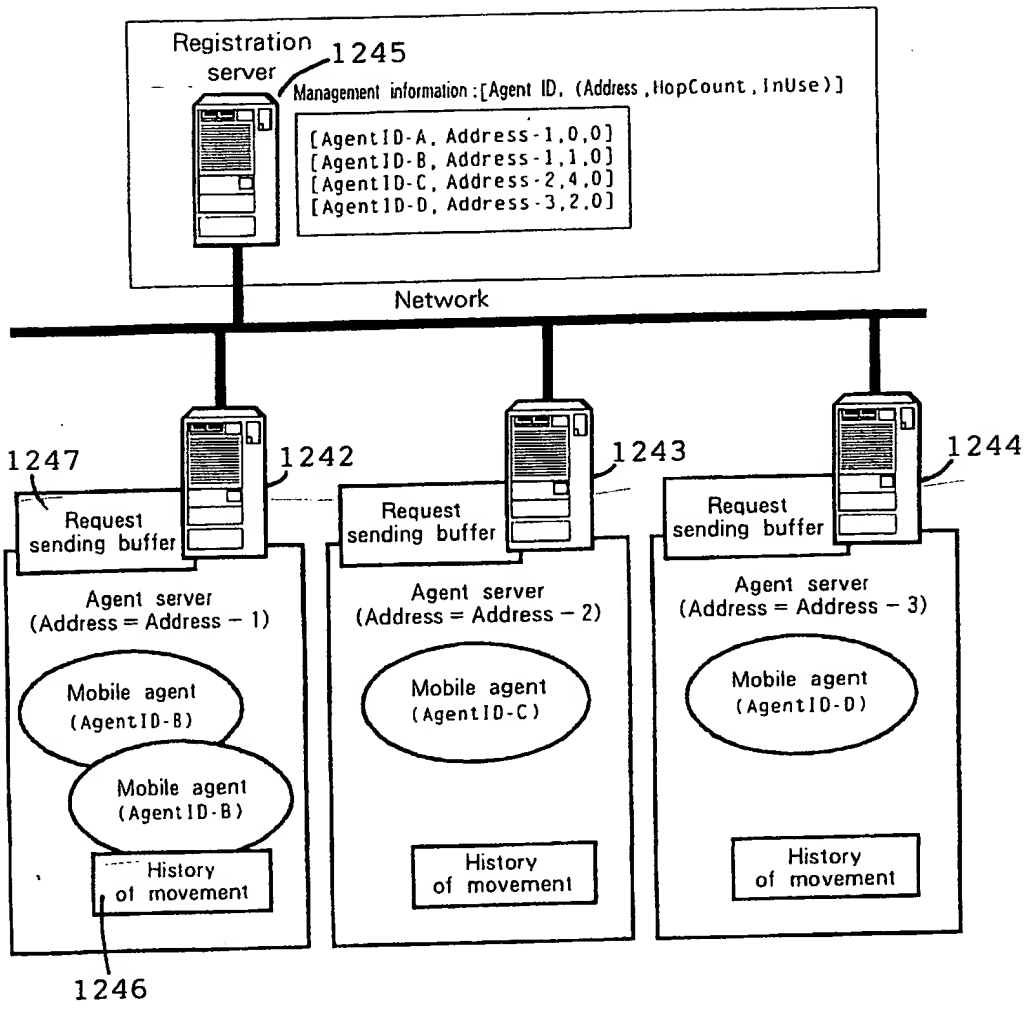

Registration server
1245
Management information :[Agent ID, (Address ,HopCount ,InUse)]
[AgentID-A, Address-1,0,0]
[AgentID-B, Address-1,1,0]
[AgentID-C, Address-2,4,0]
[AgentID-D, Address-3,2,0]
Network
1247
1242
1243
1244
Request sending buffer
Request sending buffer
Request sending buffer
Agent server (Address = Address – 1)
Agent server (Address = Address – 2)
Agent server (Address = Address – 3)
Mobile agent (AgentID-B)
Mobile agent (AgentID-B)
Mobile agent (AgentID-C)
Mobile agent (AgentID-D)
History of movement
History of movement
History of movement
1246

Fig. 12

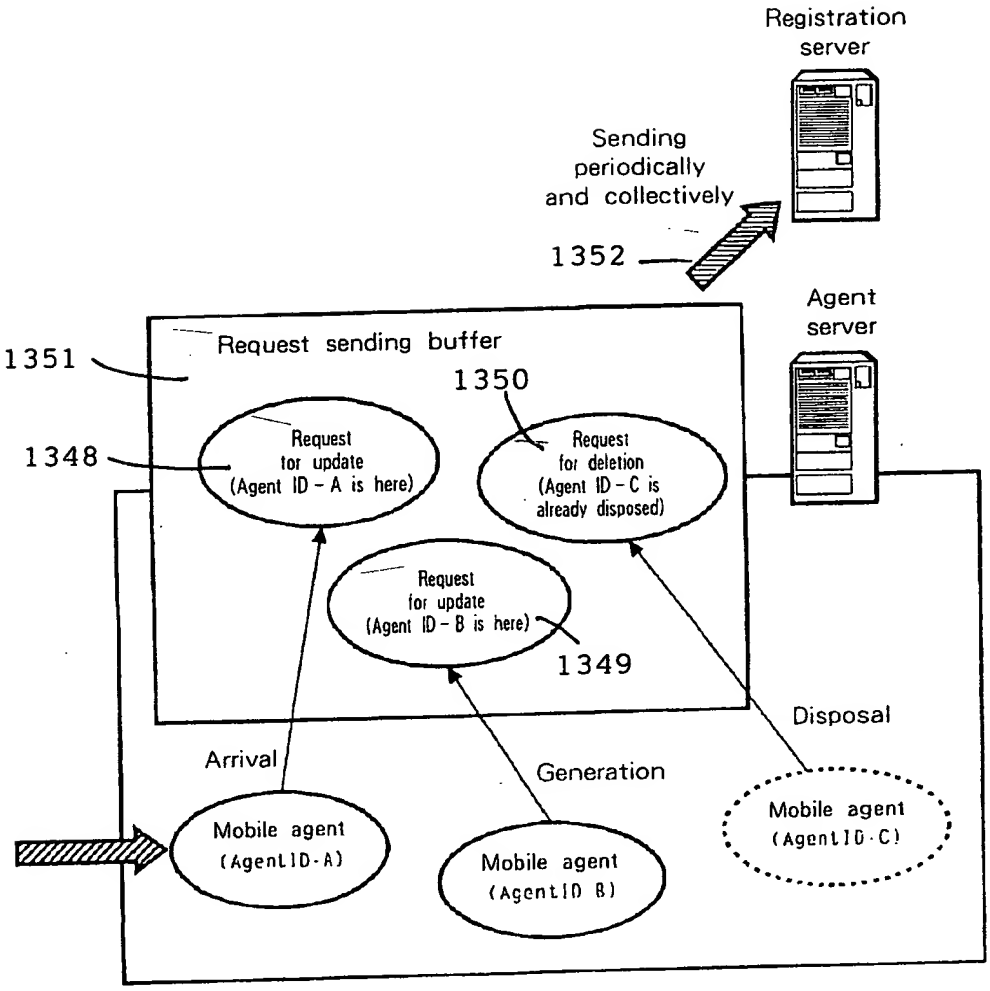

Registration server
Sending periodically and collectively
1352
Agent server
Request sending buffer
1351
1350
1348
Request for update (Agent ID – A is here)
Request for deletion (Agent ID – C is already disposed)
Request for update (Agent ID – B is here)
1349
Disposal
Arrival
Generation
Mobile agent (AgentID-A)
Mobile agent (AgentID B)
Mobile agent (AgentID-C)

Fig. 13

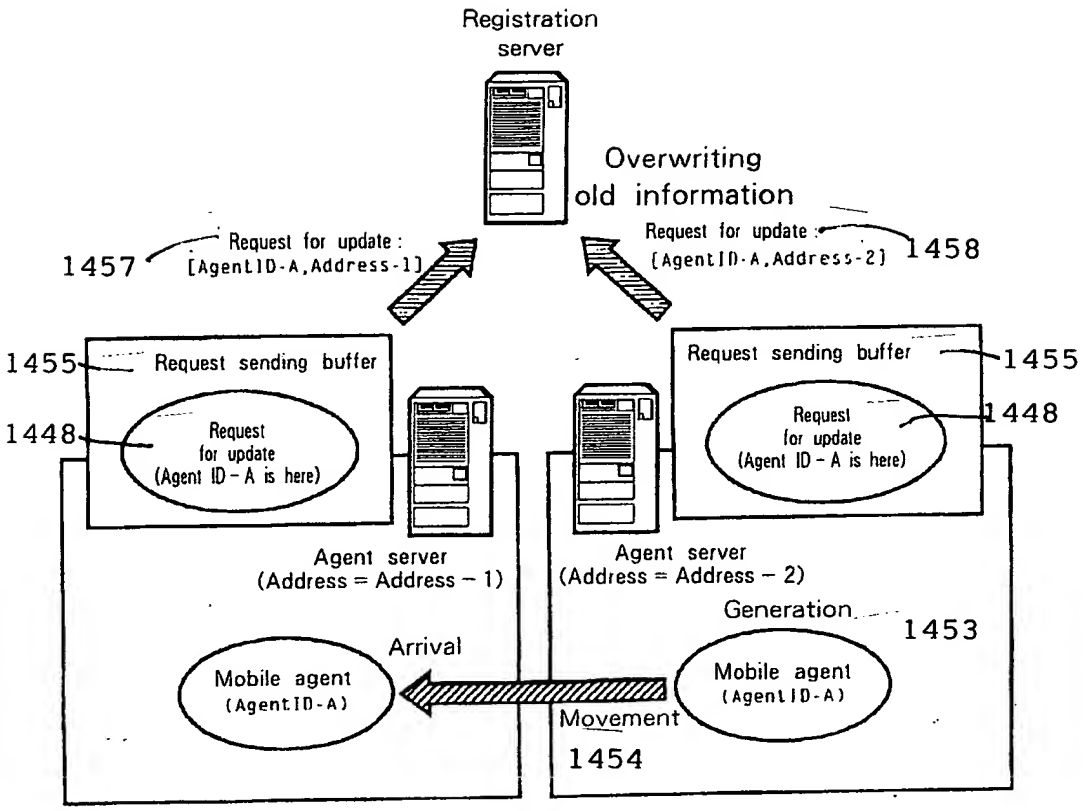

Registration server
Overwriting old information
Request for update : [AgentID-A,Address-1]
1457
Request for update : [AgentID-A,Address-2]
1458
1455
Request sending buffer
1448
Request for update (Agent ID – A is here)
Agent server (Address = Address – 1)
Request sending buffer
1455
1448
Request for update (Agent ID – A is here)
Agent server (Address = Address – 2)
Generation
1453
Arrival
Mobile agent (AgentID-A)
Mobile agent (AgentID-A)
Movement
1454

Fig. 14

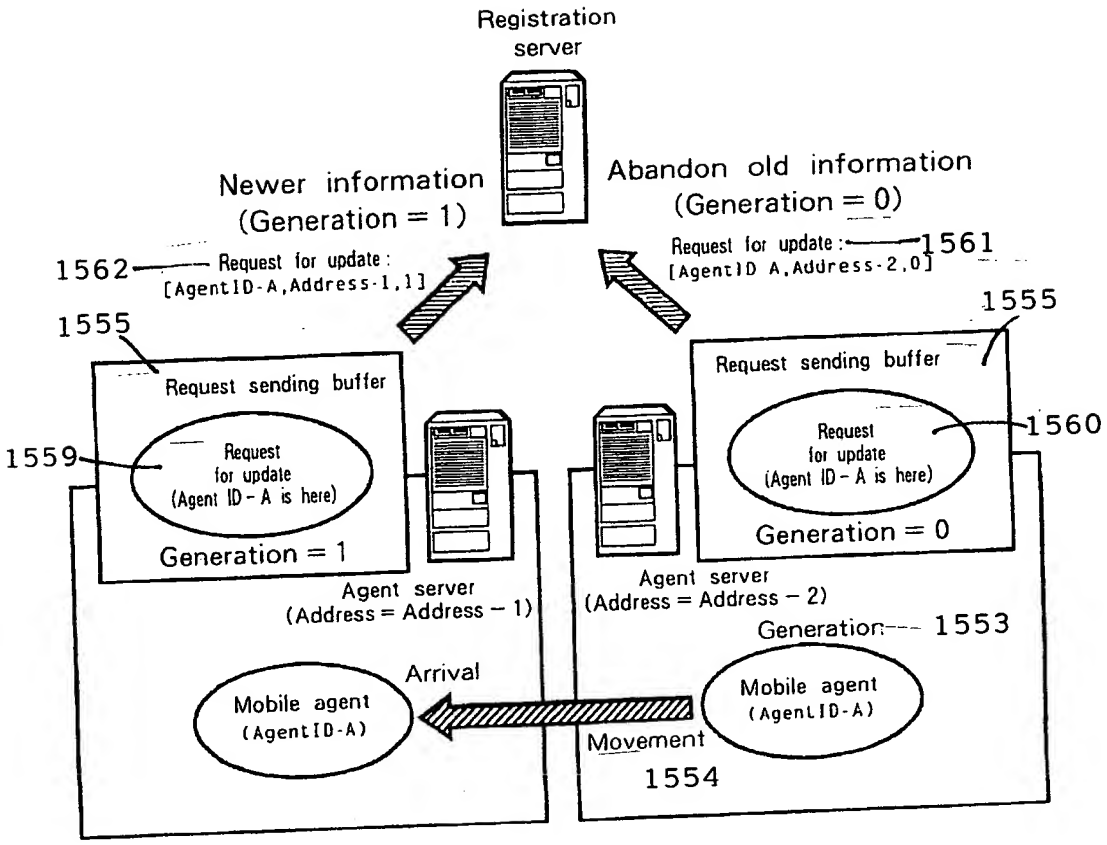

Registration server
Newer information (Generation = 1)
Abandon old information (Generation = 0)
Request for update : [AgentID-A,Address-1,1]
1562
Request for update : [AgentID A,Address-2,0]
1561
1555
1555
Request sending buffer
Request for update (Agent ID - A is here)
1559
Generation = 1
Agent server (Address = Address – 1)
Request sending buffer
Request for update (Agent ID - A is here)
1560
Generation = 0
Agent server (Address = Address – 2)
Generation
1553
Arrival
Mobile agent (AgentID-A)
Movement
Mobile agent (AgentID-A)
1554

Fig. 15

Requests to be stored in a request buffer

[AgentID, (Kind, HopCount)]

Agent
An ID of a subject mobile agent
Kind
A kind of a request
REGIST : Generation, on arrival (requests update of a management table of an arrival server)
UNREGIST : On disposal (requests deletion of an entry from a management table of a registration server)
HopCount
A request generation
When a request is generated, total accumulated number of movement of a mobile agent

Fig. 16

Entries of a management table of a registration server

[AgentID, (Address, HopCount,InUse)]

AgentID
An ID of a subject mobile agent
Address
An address of an agent server, which is a starting point of tracing a mobile agent
HopCount
A request generation
When a request is generated, total accumulated number of movement of a mobile agent
InUse
Entry use count
If 1 or more, it is in use
Used in order to prevent deletion of an entry or history of movement while tracing

Fig. 17

History of movement

[AgentID, Destination]

AgentID
An ID of a subject mobile agent
Address
An address of an agent server of a movement destination of a mobile agent

Fig. 18

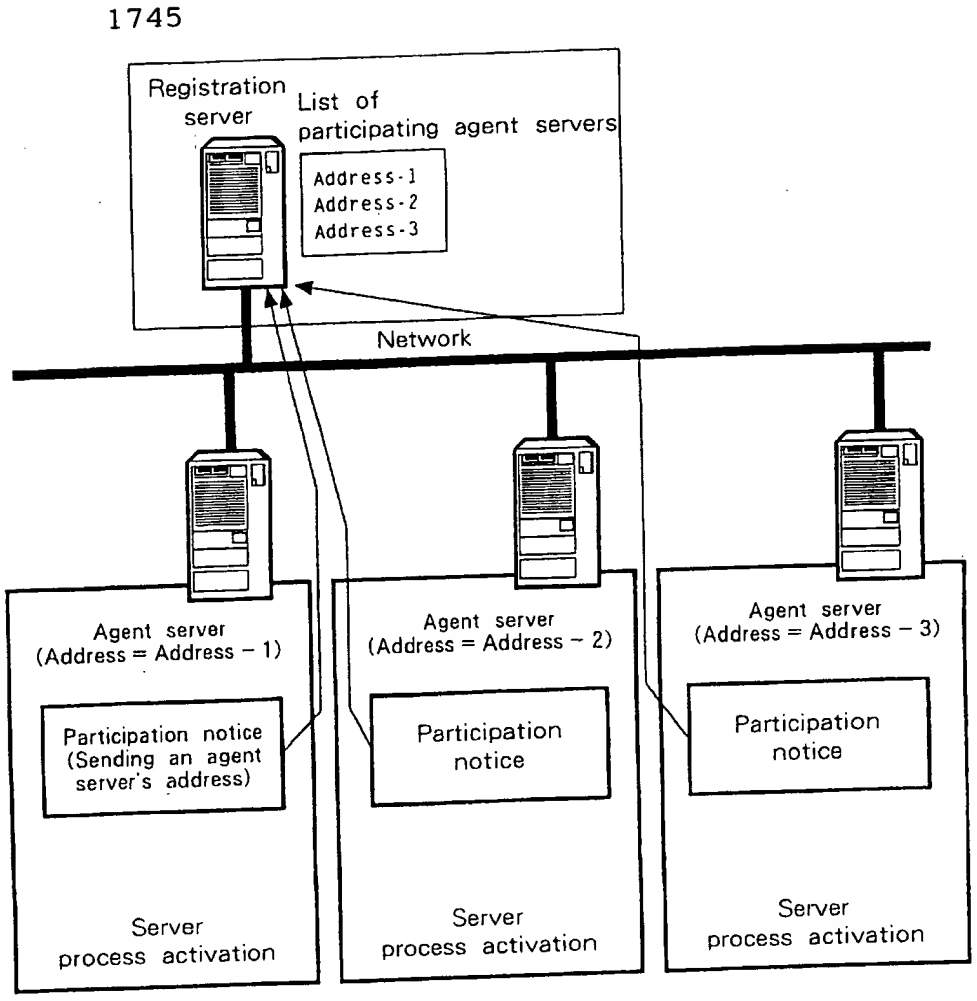

1745
Registration server
List of participating agent servers
Address-1
Address-2
Address-3
Network
Agent server (Address = Address – 1)
Participation notice (Sending an agent server's address)
Server process activation
Agent server (Address = Address – 2)
Participation notice
Server process activation
Agent server (Address = Address – 3)
Participation notice
Server process activation

Fig. 19

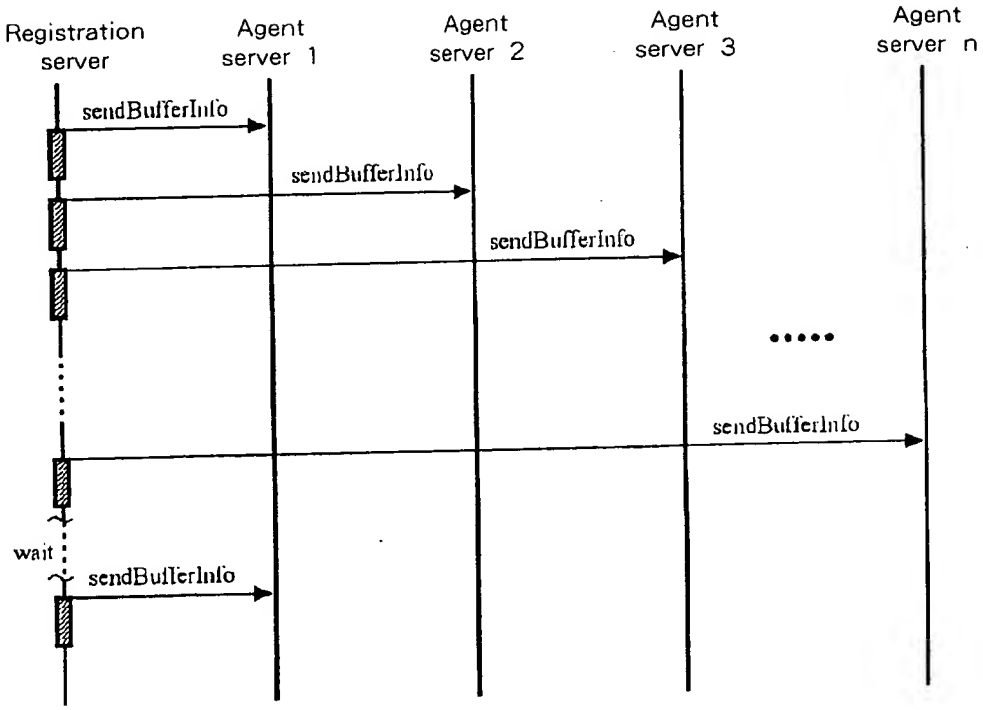

Registration server
Agent server 1
Agent server 2
Agent server 3
Agent server n
sendBufferInfo
sendBufferInfo
sendBufferInfo
sendBufferInfo
wait
sendBufferInfo

Fig. 20

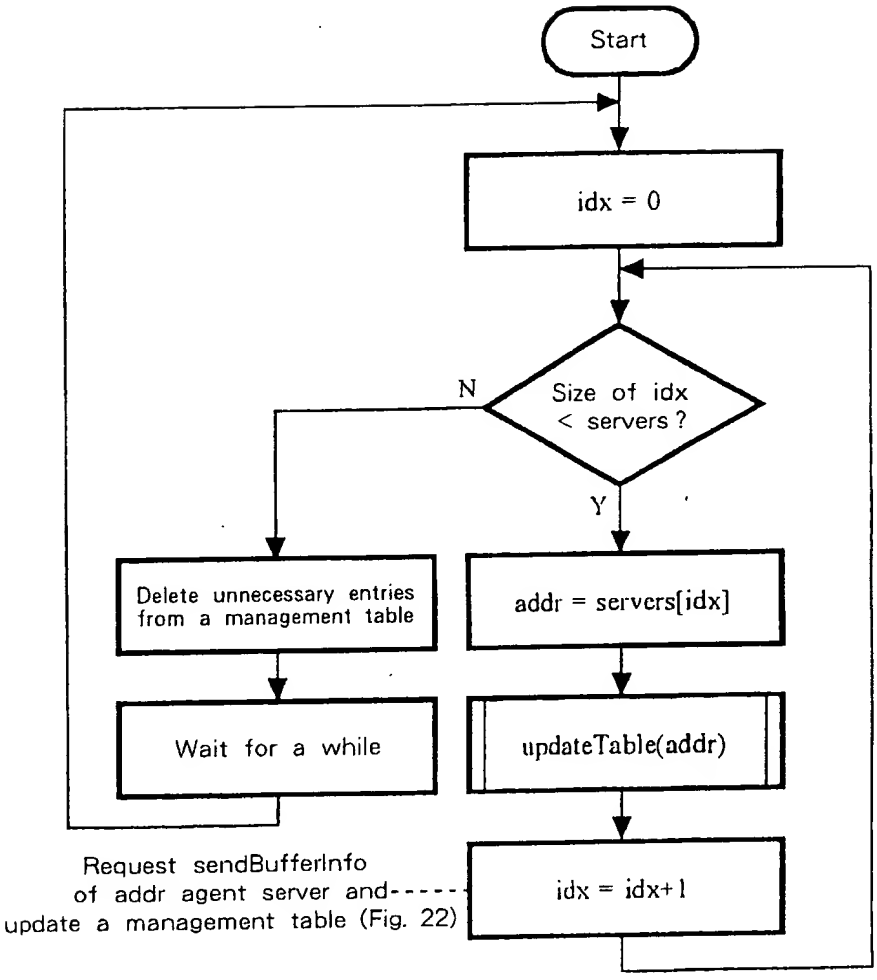

Start
idx = 0
Size of idx < servers ?
N
Y
Delete unnecessary entries from a management table
Wait for a while
addr = servers[idx]
updateTable(addr)
idx = idx+1
Request sendBufferInfo of addr agent server and update a management table (Fig. 22)

Fig. 21

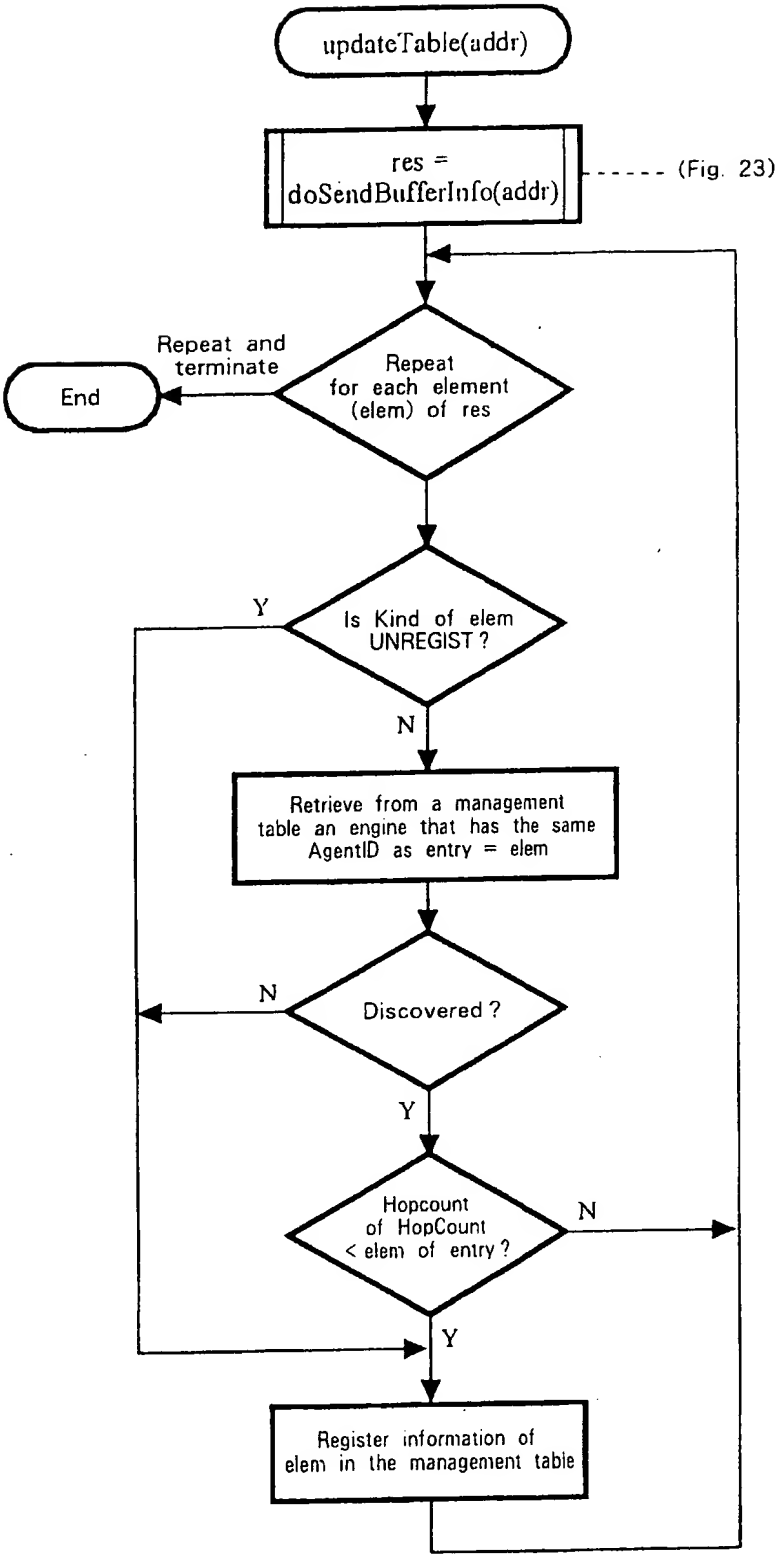

updateTable(addr)
res = doSendBufferInfo(addr)
(Fig. 23)
Repeat for each element (elem) of res
Repeat and terminate
End
Is Kind of elem UNREGIST ?
Y
N
Retrieve from a management table an engine that has the same AgentID as entry = elem
Discovered ?
N
Y
Hopcount of HopCount < elem of entry ?
N
Y
Register information of elem in the management table

Fig. 22

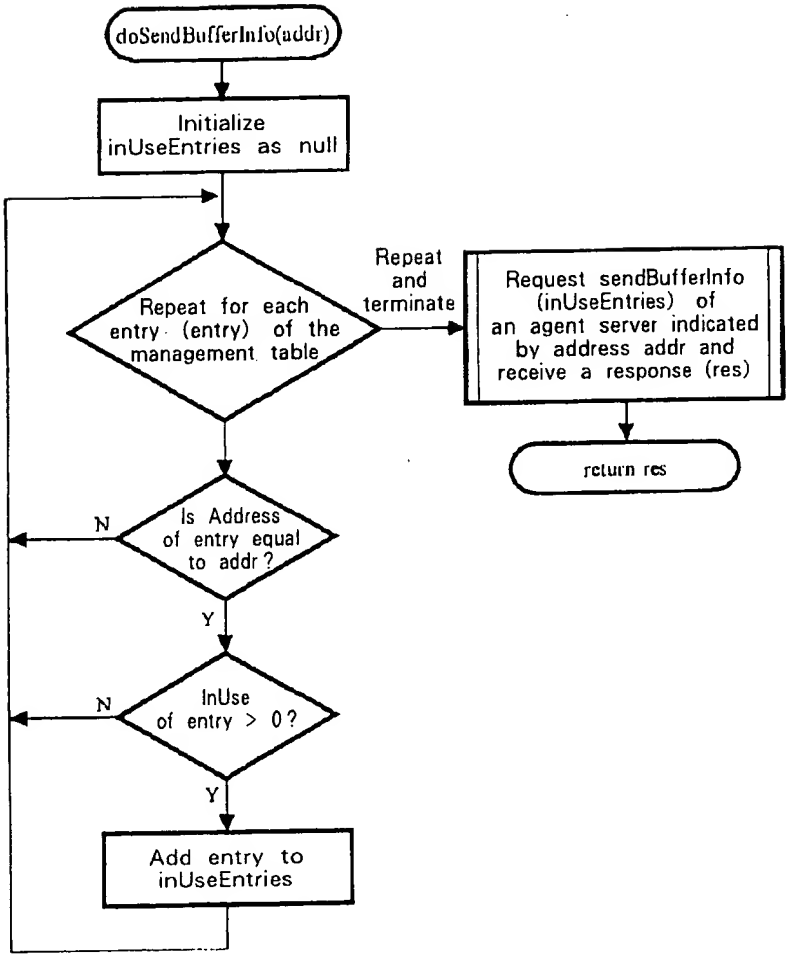

doSendBufferInfo(addr)
Initialize inUseEntries as null
Repeat for each entry (entry) of the management table
Repeat and terminate
Request sendBufferInfo (inUseEntries) of an agent server indicated by address addr and receive a response (res)
(Fig. 24)
return res
Is Address of entry equal to addr ?
N
Y
InUse of entry > 0 ?
N
Y
Add entry to inUseEntries

Fig. 23

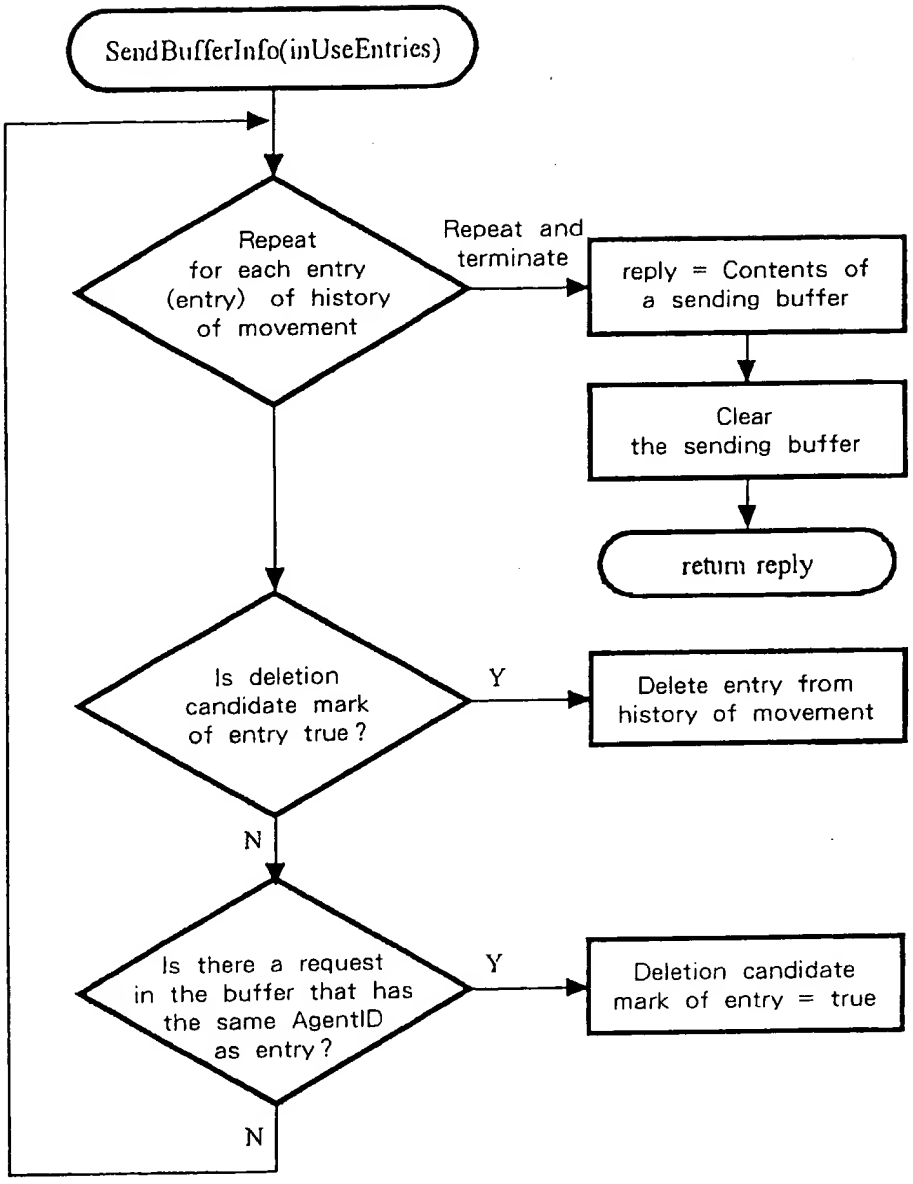

SendBufferInfo(inUseEntries)
Repeat for each entry (entry) of history of movement
Repeat and terminate
reply = Contents of a sending buffer
Clear the sending buffer
return reply
Is deletion candidate mark of entry true?
Y
Delete entry from history of movement
N
Is there a request in the buffer that has the same AgentID as entry?
Y
Deletion candidate mark of entry = true
N

Fig. 24

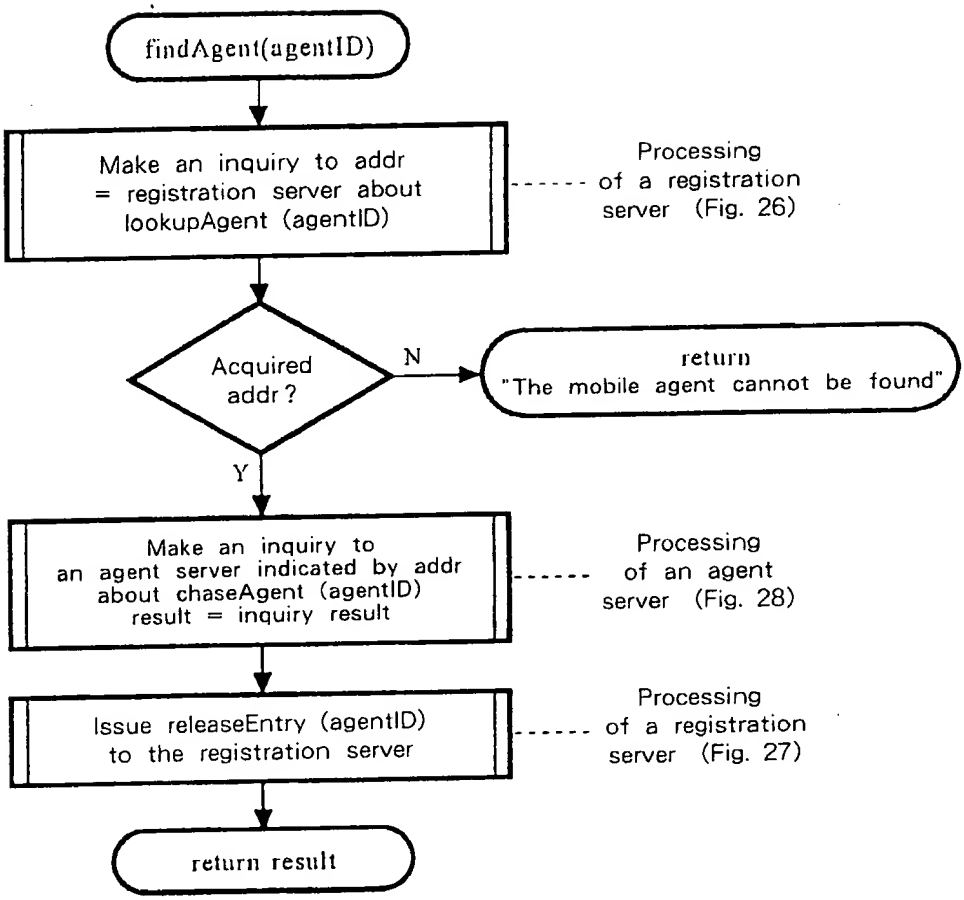

findAgent(agentID)
Make an inquiry to addr = registration server about lookupAgent (agentID)
Processing of a registration server (Fig. 26)
Acquired addr ?
N
return "The mobile agent cannot be found"
Y
Make an inquiry to an agent server indicated by addr about chaseAgent (agentID) result = inquiry result
Processing of an agent server (Fig. 28)
Issue releaseEntry (agentID) to the registration server
Processing of a registration server (Fig. 27)
return result

Fig. 25

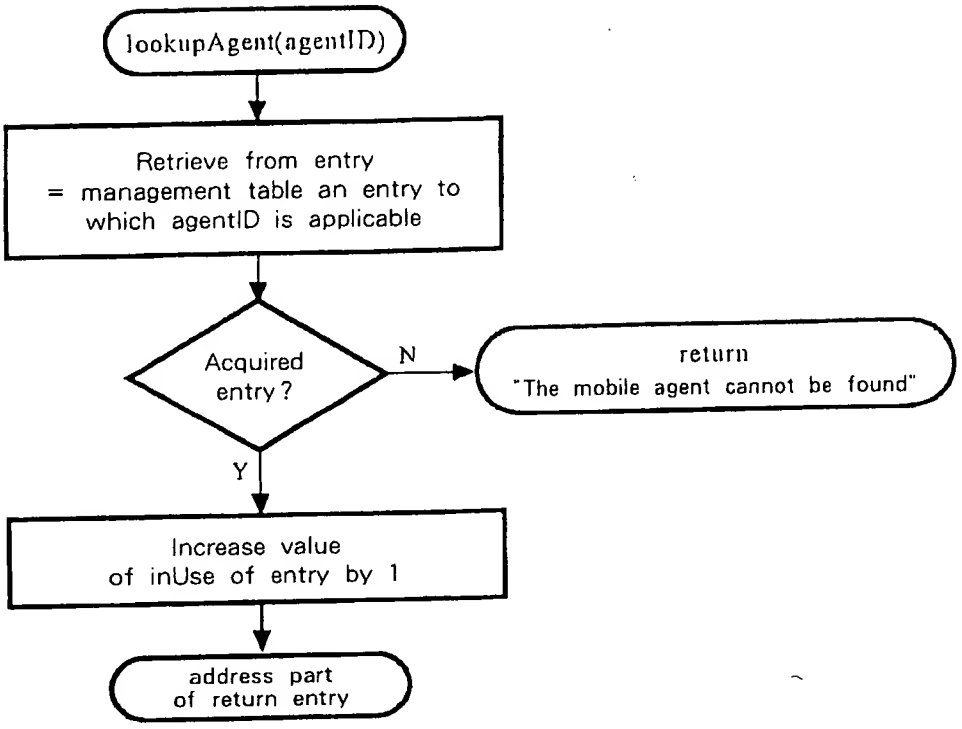

lookupAgent(agentID)
Retrieve from entry = management table an entry to which agentID is applicable
Acquired entry?
N
return "The mobile agent cannot be found"
Y
Increase value of inUse of entry by 1
address part of return entry

Fig. 26

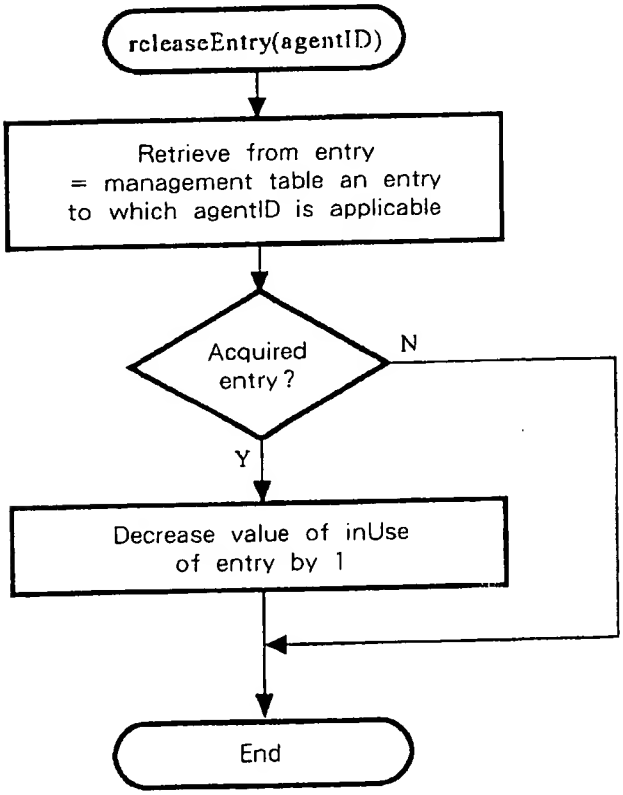

releaseEntry(agentID)
Retrieve from entry = management table an entry to which agentID is applicable
Acquired entry?
N
Y
Decrease value of inUse of entry by 1
End

Fig. 27

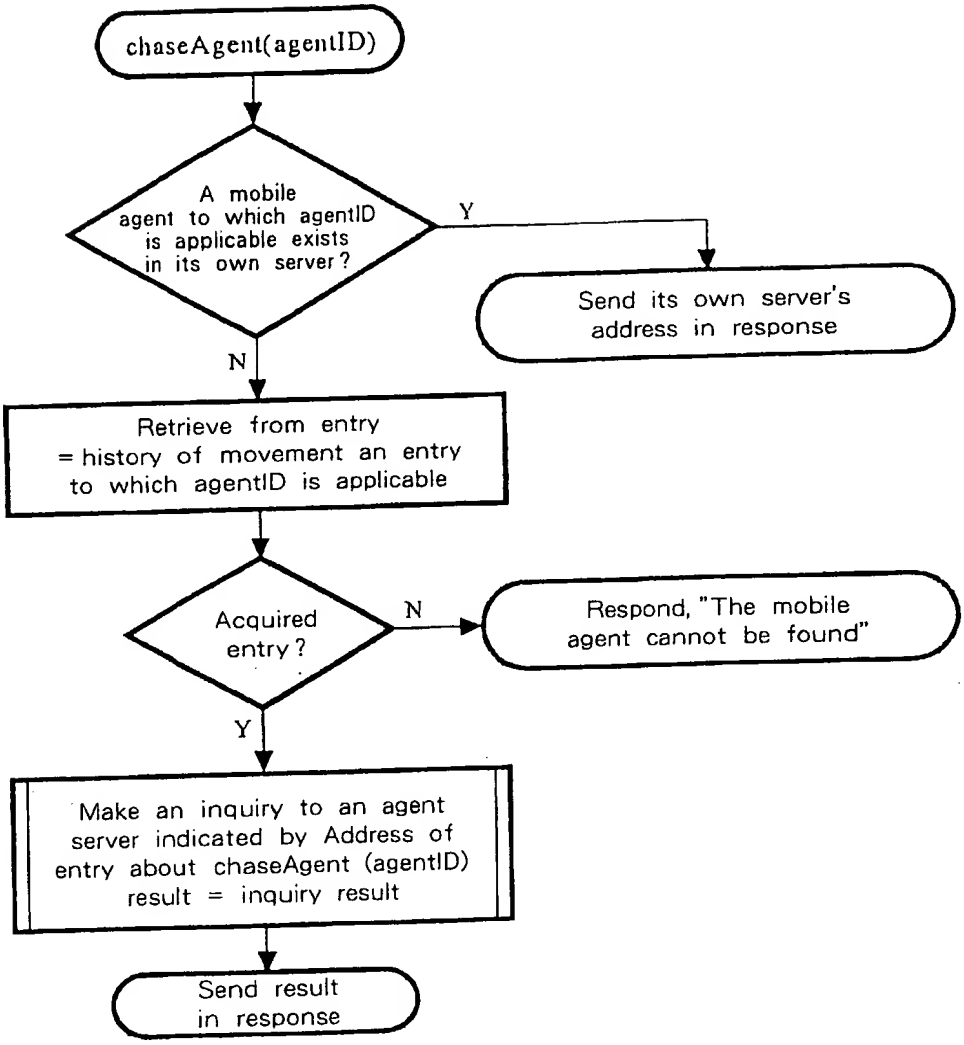

chaseAgent(agentID)
A mobile agent to which agentID is applicable exists in its own server?
Y
Send its own server's address in response
N
Retrieve from entry = history of movement an entry to which agentID is applicable
Acquired entry?
N
Respond, "The mobile agent cannot be found"
Y
Make an inquiry to an agent server indicated by Address of entry about chaseAgent (agentID) result = inquiry result
Send result in response

Fig. 28

Case 1 :
N = 9 (Total number of agents : 90)

Conventional method (Registry)	This method	No tracing facility
79,483	63,599	61,084
80,008	66,079	65,241
90,480	66,079	66,504

Fig. 29

Case 2 :
N = 15 (Total number of agents : 150)

Conventional method (Registry)	This method	No tracing facility
145,356	100,240	97,002
153,234	107,596	108,289
179,300	109,654	112,066

Fig. 30